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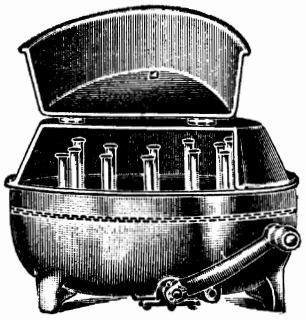
USING THE BABCOCK TEST

BY J. M. FULLER

DEPARTMENT OF DAIRY HUSBANDRY



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USING THE BABCOCK TEST

BY J. M. FULLER
Professor of Dairy Husbandry, Oklahoma A. and M. College

INTRODUCTION

The Babcock test, invented about 1890, has come into general use in this country wherever milk and cream are sold on a butterfat basis. Considerable demand exists for information regarding the use of this test. The demand comes chiefly from farmers who desire to test the milk from one or more of their cows, from buttermakers, from men who are operating or who desire to operate cream stations, from dairymen who sell milk or cream, and from ice cream manufacturers. It is the purpose of this bulletin to give all necessary information regarding the testing of milk, cream, skimmilk, buttermilk and ice cream.

TESTING MILK FOR BUTTERFAT

Outline of Process

1. Secure a representative sample.
2. Fill a 17.6 cc. pipette to mark, then allow milk to run into test bottle.
3. Add 17.5 cc. sulphuric acid and mix thoroughly with rotary motion.
4. Whirl in tester for five minutes.
6. Add hot soft water to bring fat to base of neck of bottle.
6. Whirl three minutes.
7. Add hot water till fat column shows above zero mark, but not above 8% if 8% bottle, or 10% if 10% bottle.
8. Whirl one minute.
9. Place bottle in hot water (130° to 140° F.) for five minutes.
10. Read from top to bottom of fat column.
11. Empty test bottles and wash thoroughly.

Securing a Representative Sample

A representative sample means one in which the butterfat has been evenly distributed. If milk stands without stirring for even a few minutes, the cream will begin to rise. The top layer will contain more butterfat than the rest of the milk. If a sample is taken from the top of the milk it will test higher than a sample taken from the middle or bottom of the vessel. When a representative sample is secured, it means that the milk in the bottle, pail, or can has been so thoroughly stirred that there is just as much butterfat in one portion of the milk as there is in any other portion, and then enough is taken for testing.

If the milk in a bottle or pail is to be tested, it can best be thoroughly stirred by pouring into another vessel then back again. This

should be done four or five times. Milk in a pail can be mixed by using a dipper and stirring vigorously. Creameries or dairies that receive their milk in large cans, such as the five or ten-gallon size, usually have a stirring rod or a milk sampler which enables them to get a fair sample. About three ounces of milk are enough for a sample.

Use of Preservatives

In case milk cannot be tested within a few hours after a sample is taken, a preservative should be added to prevent souring and curdling. The milk should be put into a bottle with tight-fitting stopper or a jar that is tightly covered. If samples are to be kept any length of time they should be put in a cool, dark place. Preservatives that may be used are: Corrosive sublimate, bichromate of potash, and formalin. Corrosive sublimate is very commonly used. It is sold in tablet form. Usually one tablet will preserve a half pint for two weeks. Eight or ten drops of formalin are sufficient to preserve the same amount for the same time. In case bichromate of potash is used, enough should be added to give the milk a lemon-yellow color. Corrosive sublimate is a deadly poison. Formalin and bichromate of potash are less deadly. Formalin tends to harden the casein of milk, thus making it difficult for the sulphuric acid to act readily. Of the three preservatives, corrosive sublimate is considered by many to be the best.

Filling Pipette and Test Bottle

In case a sample of milk is not tested within a few minutes after it is secured, the process of thoroughly mixing by pouring should be carried out. After thorough mixing, draw milk above the 17.6 cc. mark on pipette. Place the forefinger over the upper end, then release pressure and allow milk to run down to mark. In case lumps of butterfat appear on surface of milk, heat sample to 100° F. Pour to mix well, then at once fill pipette.

Figure 1—Pipette for measuring milk

To fill test bottle, the small end or bottom of pipette is placed at top of test bottle and pressure of finger released to allow milk to flow down one side of neck of bottle, but not fast enough to prevent the escape of air. Pipette and bottle should be held as indicated in Figure 2. The last few drops of milk can be blown into bottle.

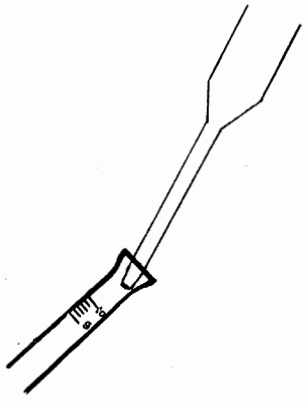

Figure 2—This illustrates angle at which milk bottle and pipette should be held when transferring milk to bottle

Adding Acid

The next step is to measure out in an acid measure 17.5 cc. of sulphuric acid and add to milk. Rotate bottle as acid runs down neck so that any milk that may have adhered to glass will be washed down with the acid. Mix acid and milk thoroughly, using rotary motion as indicated by Figure 3. Care should be taken that the acid and milk mixture is kept out of neck of bot-

tle. Mixing should be continued until curd is dissolved and the liquid has turned a dark brown color. During the process of adding acid and mixing, the neck of bottle should be pointed away from the face to avoid the possibility of acid being thrown into the eyes. The milk and acid mixture becomes very hot during the mixing process. If, for any reason, the bottles become cool before testing can be done, they should be set in hot water for ten minutes.

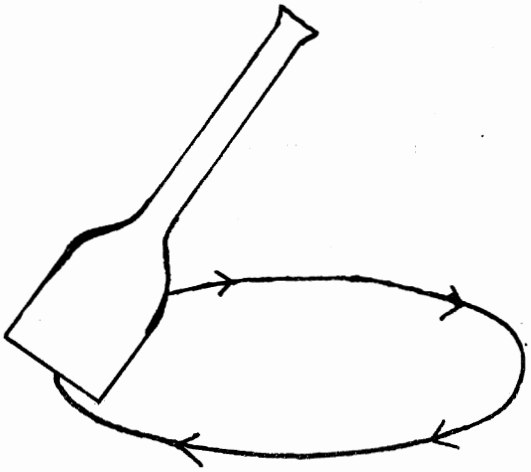

Figure 3—Milk and acid can best be mixed by whirling bottle with rotary motion

Commercial sulphuric acid having a specific gravity of 1.82-1.83 should be used. It can be obtained from any of the creamery supply houses or from local drug stores. This acid will destroy wood and metals, and for this reason should be kept in glass bottles. Holes are readily eaten in cloth and leather by sulphuric acid. It can easily blister the skin. If acid gets on the skin or clothes, it should be washed off at once with water, then some household ammonia or soda applied and washed off with more water.

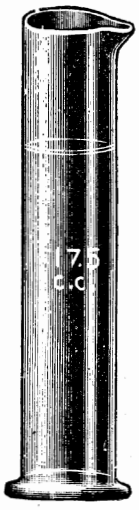

Figure 4—Acid measure

Sulphuric acid absorbs water very readily, and for this reason should be kept in a tightly stoppered bottle.

Whirling

When test bottles are placed in testers they should be "balanced", that is, placed exactly opposite. If a closed type of machine is used, the cover should always be in place before the handle is turned. Whirl five minutes at required speed. This speed is usually indicated on cover of machine. The handle of the eight- to ten-bottle covered machine is usually turned from seventy to eighty times per minute, depending upon the size and make. The open two-or four-bottle tester is run at a somewhat higher speed.

As soon as the bottles have been turned five minutes, allow the tester to stop. Hot soft water is then added to each bottle. The water should be at least so hot that a person may dip his finger into it without being burned. It may be boiling hot and not injure the test in any way. A pipette or a small dipper can be used to add water. Water should be added to bring liquid to neck of bottle. Whirling is again done for three minutes. More hot soft water is then added to bring the fat above the zero, but not above the 8% or 10% mark. Whirl one minute. Remove the bottles and place in water having a temperature of 130° to 140°. The water should be as high as the fat in neck of bottles. Placing the bottles in water keeps the liquid fat from solidifying before reading can be done. If a steam tester is used, the bottles usually remain at required temperature until read. It is especially desirable, however,

that bottles from the open style testers and from the closed hand-testers be placed in hot water to avoid cooling of fat. If the test has been carried out correctly, the butterfat will appear in the neck of the bottle as a liquid with a clear, golden-yellow color.

Reading the Test

The reading is made from the top to the bottom of the fat column. Figure 5 illustrates the method of reading the test in a 10% bottle. A pair of dividers should be used. The bottle is held on a level with the eyes and one point of the dividers is placed at the bottom of the fat column with the other point at the top. Then without changing the distance between the points of the dividers, one point is placed on zero. The other point will register the percent of fat.

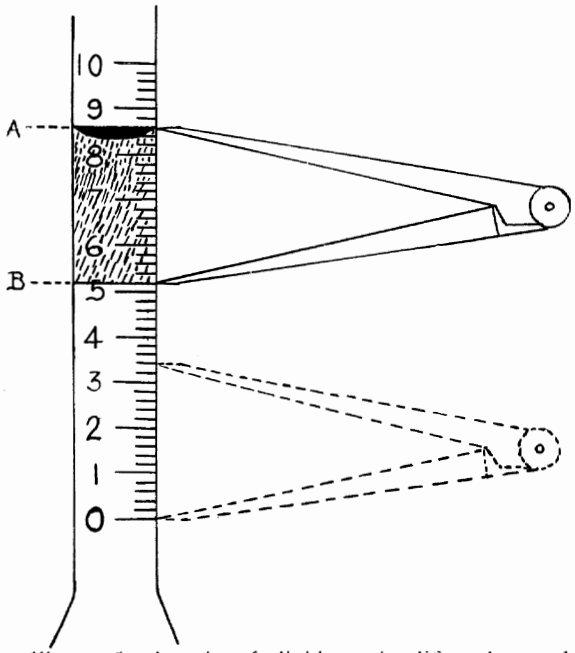

Figure 5—A pair of dividers simplifies the reading of fat column. Reading is made from A to B

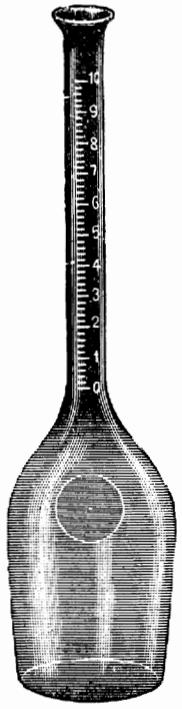

Figure 6—Milk test bottle

The scale on the neck of a 10% bottle is divided into ten large divisions. Each of these is divided into five small divisions. Each large division represents 1% and the small division 0.2%. The 8% bottles have eight large divisions, each of which is divided into ten parts. Each large division represents 1% and each small division 0.1%. Ten percent bottles, on account of having larger openings in the neck, are more easily handled by inexperienced persons.

If the fat column covers four large and two small spaces on the neck of a 10% bottle, the test would be 4.4%. This means that 100 pounds of milk testing 4.4% contain 4.4 pounds of butterfat. A sample of milk should be tested in duplicate, that is, two bottles should be used. If the reading varies more than 0.2%, then another test should be run. For instance, if one bottle reads 3.4% and the other 3.7%, inaccurate work has been done and another test should be made.

Washing Test Bottles

As soon as the tests have been recorded, the bottles should be emptied. Shake while emptying, as this will aid in removing the white deposit in the bottom of the bottles. Next, add half a pipette of hot water. Rinse and empty, then wash thoroughly in hot soft water to which a washing powder or soda has been added. Soap may be used. Rinse in hot soft water. A test bottle brush may be necessary to remove specks from the neck of the bottle.. In case washing fails to remove white material from bottom of bottle, a little sulphuric acid will usually remedy the trouble.

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TESTING TROUBLES

First: The column of fat is dark and contains black specks or black material at the base. This trouble is due to one or more of the following:

1. Acid is too strong.
2. Temperature of milk or of acid or of both is too high. The temperature of milk and acid should be room temperature, or around 70° F.
3. Too much acid was used.
4. Mixing was not properly done.

Second: The fat column is too light in color or contains white, curdy material at the base. This trouble may be due to one or more of the following:

1. Milk or acid or both too cold.
2. Acid too weak.
3. Not enough acid.
4. Improper mixing.

Third: Bubbles appear at top of fat column. This trouble is due to using water containing certain minerals, or, in other words, to using hard water. If a few drops of sulphuric acid are added to every half pint of water that is to be added to the bottles, this trouble may be overcome.

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TESTING COWS ON THE FARM

The Babcock tester can be used by a farmer to determine the amount of butterfat produced by each cow of his herd. If a record is kept of the amount of feed given each cow, it is an easy matter to decide which animals are worth keeping.

A cow may give a large flow of thin milk for three or four months. For the remainder of her lactation period she may give only a small flow. Another cow may give a fairly small amount of rich milk during her entire lactation period. The first cow will likely be given credit by the farmer for being a very good producer, when, as a matter of fact, she may not be nearly as profitable to keep as the second cow. Three things are necessary to enable a farmer to determine whether or not a cow is profitable: First, total pounds of milk given in a year; second, the percent of butterfat in the milk; and third, the value of feed consumed.

If it is desired to find the exact yearly production of a cow, then it is necessary to weigh and test the milk during the entire time she is milked. The farmer who milks a few cows very seldom cares to do this. He can, however, by testing the milk from each cow one day a month and by weighing the milk at each milking during the

month, determine very closely just what each cow is producing. It has been found in many cases that this method gives results that are more than 95% correct. If this plan is followed, a milk sheet should be ruled as illustrated in Figure 7.

Month____ Milk Sheet

Cow's Number	1		2		3		4		5		6		7		
Date	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	
1															
2															
3															
4															
5															
6															
7															
8															
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28															
29															
30															
31															
Total A.M.-P.M.	420	471													
Total	891														
Test	3.46%														
Lbs. Butterfat	32.07														
Value	$9.62														

Figure 7—Milk and butterfat records are easily kept if milk sheet is properly ruled

The milk from each cow is weighed and the weight recorded as soon as milking is done. The monthly test should be made the same day each month. The morning's and evening's milk do not usually contain the same percent of butterfat, so it is necessary to test twice on the day the monthly testing is done.

After the milk from a cow has been weighed and the weight recorded, samples can be taken. The milk can be poured from one pail to another or it can be stirred with a dipper. The proper amount should at once be transferred to two test bottles. The cow's number should be marked on these bottles.

The average test for the day is found as follows: Suppose that in the morning, Cow No 1. gave twenty pounds of milk that tested 3.8%. In the evening, twenty-five pounds of milk testing 3.2%—then,

20	times .038	equals	.76 pounds butterfat
25	times .032	equals	.80 pounds butterfat
45			1.56

Forty-five pounds of milk contain 1.56 pounds of butterfat. The test is found by dividing the pounds of butterfat by the pounds of milk and multiplying by 100. Then 1.56 divided by 45 and the answer multiplied by 100 gives 3.46, or the average test for the day.

The pounds of butterfat produced during the month are found by multiplying the total pounds of milk for the month by the average test for the one day upon which testing was done. By comparing the income from the butterfat with the cost of feed, the dairyman is enabled to know just what each cow of his herd is doing.

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COW TEST ASSOCIATIONS

Even though it is quite important that farmers know how much their cows are producing, they very often consider it too much trouble to weigh and test the milk. This difficulty is overcome in many sections of the country by organizing a cow test association. Usually about twenty-five farmers are in an association. A man is employed to do the testing and weighing and to keep records. He spends one day at each farm. The cost per cow usually runs from $1.00 to $1.50 per year. For example, twenty-five farmers may own 480 cows. If the tester is paid $40.00 per month, he will receive $480 for a year's work. The cost per cow will then be $1.00 per year.

The first cow test association originated in Denmark in 1895. There are now estimated to be from 2,500 to 3,000 such associations in Europe. The first association in America was organized in Fremont county, Michigan, in 1905. There are now about one hundred and seventy associations in this country. Thus far Oklahoma has not organized a test association, due primarily to the fact that dairy herds have not been numerous enough in a neighborhood.

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CREAM TESTING

The main difference between the methods of testing milk and cream is that cream is weighed instead of being measured. Following are the three reasons why cream is weighed:

First: A given volume of rich cream weighs less than the same volume of thin cream; second, cream is viscous or sticky so that more or less of it adheres to the inside of pipette; third, cream contains more or less air bubbles.

Steps in Testing

1. Secure a representative sample. 2. Weigh into cream bottle 9 or 18 grams of cream, according to size of bottle. 3. Add half a pipette (or about 9 cc.) of clean soft water. 4. Add 14 cc. sulphuric acid and mix thoroughly with rotary motion.

Now proceed as in milk testing. When bottles have been whirled the last time, they should be placed in water having a temperature of 130° to 140° F. till read.

Securing a Sample

A large enough sample should be secured so that in case an error is made in testing, enough cream will be left for another test. Many testers use a two-ounce bottle to hold samples. As in the case of milk, care should be used to secure a representative sample. Pouring from one can or vessel to another, as suggested for milk sampling, will give the desired result. Creamery men and cream station operators should have a stirring rod or sampler to secure samples.

Vigorous stirring with a stirring rod will enable a tester to secure a representative sample from a can of cream. In case testing is not done immediately, sample bottles should be tightly closed to prevent evaporation.

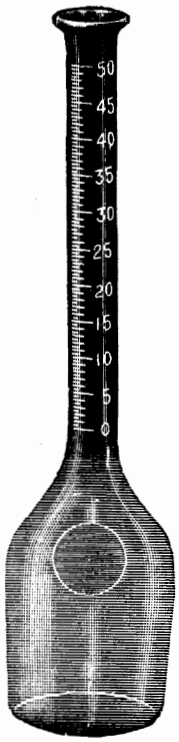

Figure 8 — Nine-gram 50% cream bottle

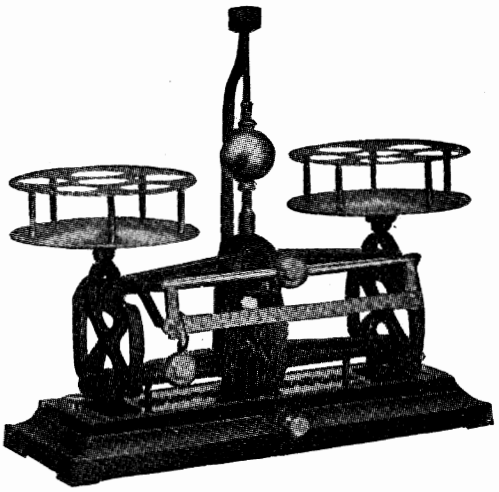

Figure 9—Twelve-bottle cream scales

Weighing

Accuracy in weighing is very important. Many who test cream use sufficient care in all the steps in testing, but do not secure accurate results because the scales used are inaccurate. The 12-bottle scales, shown in Figure 9, are fairly sensitive when in good condition. They do not stay in good repair in many cases, and as a result the operator's tests may be as much as 2% or 3% too high or too low. Figures 10 and 11 illustrate scales that weigh quite accurately. Cream scales should be sensitive to one-tenth (.1) of a gram. They should be protected from dust, moisture, acid or other agents that are sure to make them inaccurate.

Adding Water to Acid

The reason for adding water before adding acid is that clearer tests will be obtained by one who is learning to test. Those who have had some experience in testing usually add acid to the cream, and then mix. In such cases enough acid is added to give the liquid in the test bottle a dark chocolate color, then about 9 cc. of water are added to check action of acid. If this method is followed, 9 cc. of acid are usually sufficient.

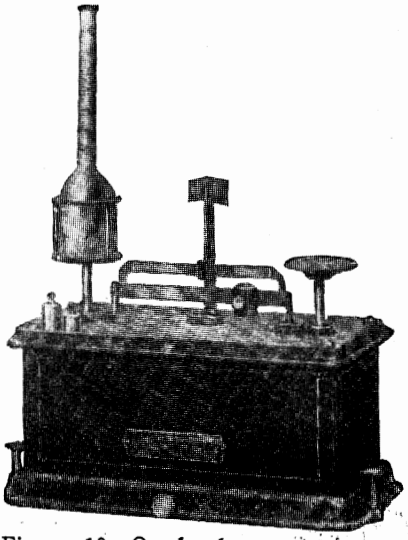

Figure 10—One-bottle cream scales

Reading

Dividers should be used as in case of reading milk test. One point should be placed at bottom of curve

(or meniscus), which appears at top of fat column, and the other at bottom of column. The type of cream bottle most generally used is the 9-gram, 50%, with 6-inch neck. The necks of these bottles are marked into 100 spaces, each space representing .5%. The 18-gram, 30% bottles can be used to test cream containing more than 30% by using nine grams of cream and doubling the reading.

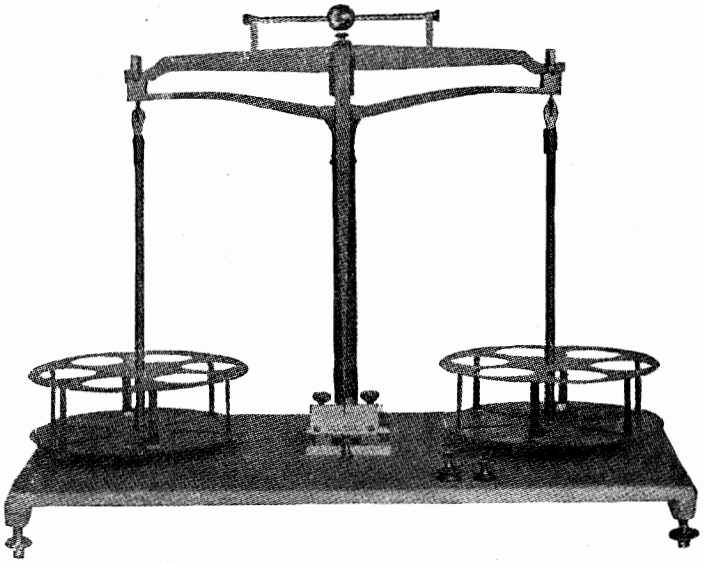

Figure 11—A desirable type of 12-bottle cream scales

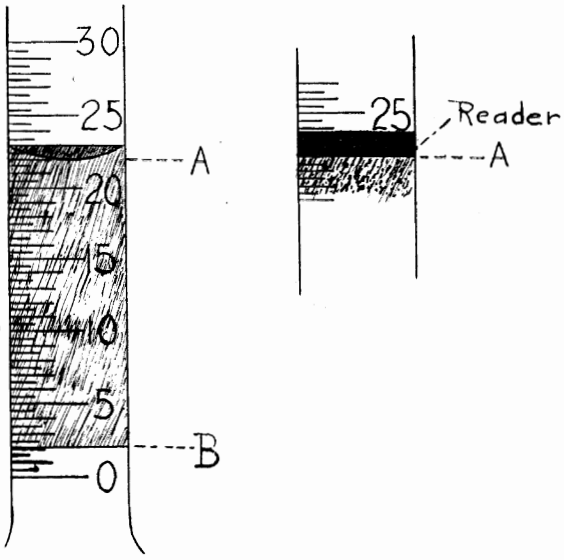

Figure 12—In reading cream tests, the fat column is read from bottom of meniscus to bottom of column, or from A to B. The smaller drawing illustrates how the use of a "reader" levels top of fat

Unless a clear fat column has been obtained it may be difficult to see the bottom of the mensicus. This difficulty may be overcome by using a "reader" to level the top of fat column. High grade mineral oil, such as sewing machine or typewriter oil, properly colored, makes a very good reader. Parafin oil or high grade cream separator oil may be used. These oils may be colored by using alkanet root at rate of one ounce to one quart of oil. Place the alkanet in a small cheesecloth bag and suspend it in the oil for two days. Some use separator oil without coloring.

Troubles in securing a clear fat column are due to similar or to the same causes as in testing milk.

Does Sour Cream Show Higher Test?

Some believe that cream will show a higher fat test if allowed to become sour. This belief is wrong, since cream that becomes sour will test no more than it would when sweet. The amount of acidity or sourness in cream neither increases nor decreases the amount of butterfat, nor does the acidity affect the test.

Since the quality of cream has a direct influence on the quality of butter, the holding of cream to allow it to sour is very bad practice. It is sometimes difficult to secure a representative sample of sour cream, and thus the accuracy of the test may be influenced.

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WHY CREAM TESTS VARY

Patrons of creamery or of cream station sometimes complain that the tests of their cream vary from week to week. They assume that the man who does the testing either does not know how to test or else is not reporting the true tests. Both conditions are possible. As a matter of fact, however, a separator may deliver cream that varies considerably in test from one day to another. Several factors govern the richness of cream delivered by a separator, and unless those factors are the same from day to day the test is bound to vary.

Speed.—One of the important factors in influencing the cream test is the speed of separator. The manufacturer of a separator has determined the speed at which it should be turned to secure best results. If the speed of the bowl is 5,000 times per minute, and the handle is to be turned fifty times per minute, then the bowl turns 100 times at every turn of the handle. If, instead of turning fifty times, the handle is turned sixty times, then the speed of the bowl is increased 1,000 times per minute, or 20% over what it should be. This increase has a direct influence on the richness of cream separated. Cream testing as high as 60% or as low as 15% or 20% may be obtained by varying the speed.

Inflow.—The rate at which the milk flows from the tank into the bowl has considerable influence in varying the cream test. If the inflow is very small, cream testing as high as 50% or 60% may be obtained. If the inflow is too large, then cream testing as low as 15% may be obtained. The float governs the inflow and should always be used.

Temperature.—Milk should be separated soon after it comes from the cow. This means that the temperature will be around 90°, or somewhat above. If milk becomes cold, say 50° to 60°, it separates with more difficulty. The cream will be richer and more butterfat will be lost in the skimmilk than if separated at 90°.

Richness of Milk.—If a separator delivers 20% cream from 3% milk, then from 6% milk it may be expected to deliver cream testing 35% to 40%. The milk from a herd of cows usually tests practically the same from day to day. If the herd is small, and two or three fresh cows are added, the average test for the herd will likely be lowered, especially if the other cows in the herd are advanced in their lactation period.

Cream Screw.—Once adjusted, the cream screw should not be a factor in causing a variation in the test. If for any reason it is turned, then a variation is sure to follow. A separator should deliver 35% to 40% cream in summer and somewhat thinner, say from 30% to 35%, in winter.

Other Factors.—The condition of the machine and the amount of flush water used may sometimes influence the cream test. If the separator is placed on a level, solid foundation, and is properly run and cared for, there should be no trouble from this factor. Unless an unusual amount of flush water is used, this factor will have little influence in varying the test.

Unless the different factors that control the richness of cream are the same from day to day, the operator of a separator should not expect to have his cream test the same each time. Knowing these factors, the operator will be able to understand why the cream test varies and will better be able to control these variations.

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TESTING CREAM ON THE FARM

A farmer seldom cares to buy a pair of scales for testing cream. It often happens, however, that he desires to know about how rich the cream is that his separator is skimming. The pipette method of testing will give this information. If care is used in making the test, the pipette method should give results that are within about 1% of test obtained by weighing. If one has a milk-testing outfit, then a 9 cc. pipette and two 9-gram, 50% cream bottles are all that will be required.

Only sweet cream should be tested. The temperature of cream and of acid should be around 70°. Measure 9 cc. cream with pipette and add to cream bottle. Rinse pipette by filling to mark with clean soft water, then allow it to run into bottle. Turn bottle as water runs down neck to rinse cream into bottle. Add 14 cc, acid and complete test according to directions given for testing cream.

When test has been completed, correct reading according to following table:*

Percent Cream Obtained by Pipette Method	Correction to be Added
24% or less	.0%
25%-29%, inclusive	.5%
30%-34%, inclusive	1.0%
35%-39%, inclusive	1.5%
40%-45%, inclusive	2.0%
46%-49%, inclusive	2.5%
50%-54%, inclusive	3.0%
55%-58%, inclusive	3.5%
59%-60%, inclusive	4.0%

The following illustration shows how table is used:

Percent as Shown by Reading	Correction to be Added	Correct Test
43%	2%	45%

Should a cream station, or a creamery, or any person buying cream on a butterfat basis use the pipette method? No; for in such cases cream should be weighed for testing.

*From Bulletin 152, South Dakota Experiment Station.

TESTING SKIMMILK AND BUTTERMILK

Skimmilk is tested practically the same as whole milk, excepting that a double-neck test bottle is used and about 20 cc. of acid are required. The machine should be whirled a minute longer than when testing whole milk. Care should be taken that the bottles are hot when read.

The usual amount of acid (17.5 cc.) is used in testing buttermilk. Otherwise the method is the same as in testing skimmilk.

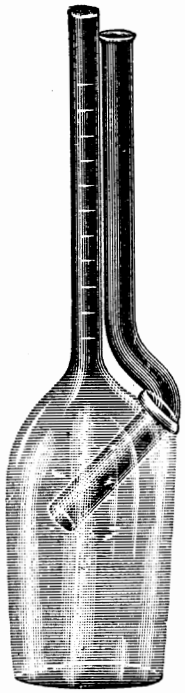

Figure 13—Skimmilk bottle

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TESTING ICE CREAM

Owing to the fact that ice cream contains sugar and usually a binder, such as gelatine or gum tragacanth, difficulty is experienced in testing. Some modification of the method for testing ice cream is, therefore, necessary. Two methods may be used.

Hydrochloric and Acetic Acid Methods

If possible, small samples should be secured from several parts of the container. Place sample bottle in water at temperature of about 100° F. and melt the ice cream. Mix by pouring, and weigh out nine grams into test bottle. Add thirty cubic centimeters of a mixture consisting of equal parts by volume of concentrated hydrochloric acid and 80% acetic acid. Mix thoroughly, then set bottles in very hot water till the liquid in bottles is dark. There should be no signs of charring. Whirl, add hot water, and complete test as in case of cream. If any of the material in bottles is charred, testing should be repeated. Thorough mixing of acid and cream aids in securing a clear test.

Milk bottles may be used for testing ice cream. In such a case, nine grams are weighed out. The reading should be doubled.

Modified Babcock Method

Prepare sample and weigh nine grams into 8% or 10% test bottle. Add about twelve cubic centimeters of warm soft water and mix. Now add three or four cubic centimeters of sulphuric acid and mix thoroughly. Continue to add acid in like amounts, mixing thoroughly each time. Bottles may be allowed to stand a short time between additions of acid. When the liquid assumes a dark chocolate color it shows that enough acid has been added. Water may be added if the color promises to become too dark. Complete test as in case of milk. Double the reading.

Either method when properly followed out will give a clear fat column.

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BABCOCK TEST APPARATUS

Babcock testers can be had in three general types. The open two-bottle or four-bottle hand tester is used where a low-priced machine is desired, and where a comparatively small number of tests are run. The closed hand-tester can be had in six, eight, ten, twelve, or twenty-four-bottle sizes. Closed testers run by steam or electric power may be had in twenty-four, thirty-two or forty-bottle sizes.

The two-bottle open tester, with glassware and acid for making a limited number of milk tests costs around $4.00; the four-bottle, $5.00.

The six-bottle closed hand-tester costs around $8.00, and larger sizes correspondingly. With this type the bottles are completely

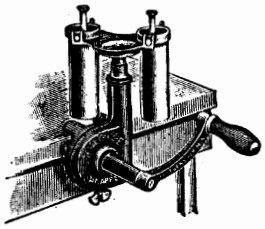

Figure 14—Two-bottle hand tester

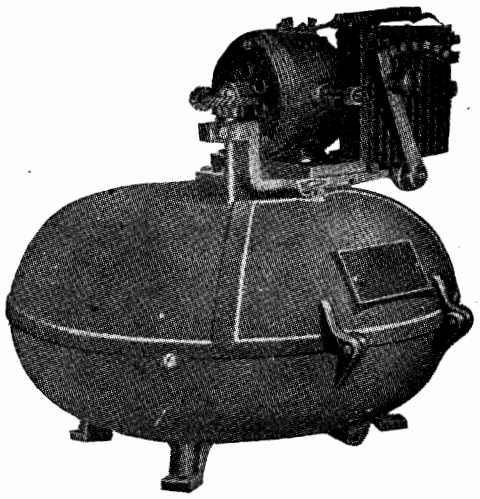

Figure 15—Babcock electric tester

enclosed, thus doing away with danger from flying acid or glass should a bottle break.

Milk test bottles cost about $1.00 per dozen. The 6-inch, 9-gram cream bottles cost about $1.50 per dozen. Pipettes cost about $1.25 per dozen, 17.5 cc. acid measures $1.00, and dividers from 25 cents to 40 cents each. Skimmilk test bottles cost 25 cents to 50 cents each. Scales for weighing cream cost from about $4.00 for a single bottle type up to around $20.00 for the best type of twelve-bottle scales.